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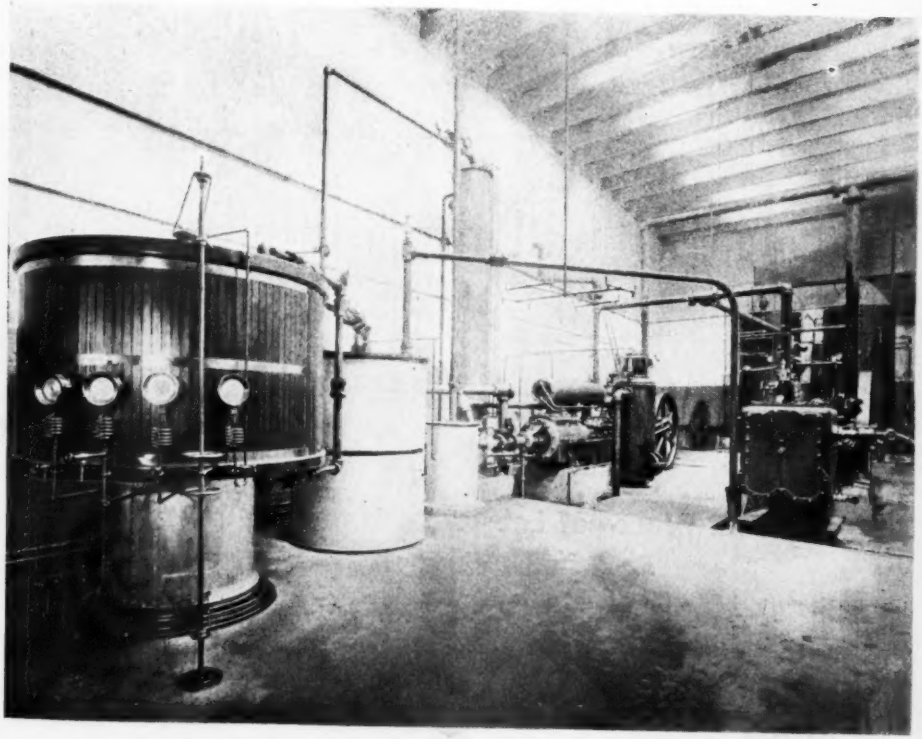
Compressed Air

DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR

VOL. IV. NEW YORK, JULY, 1899. No. 5



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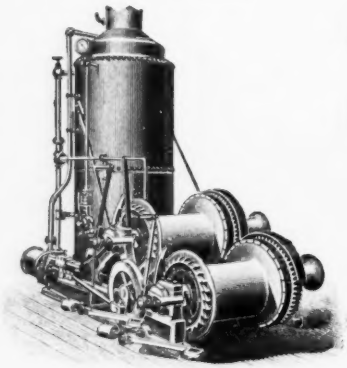

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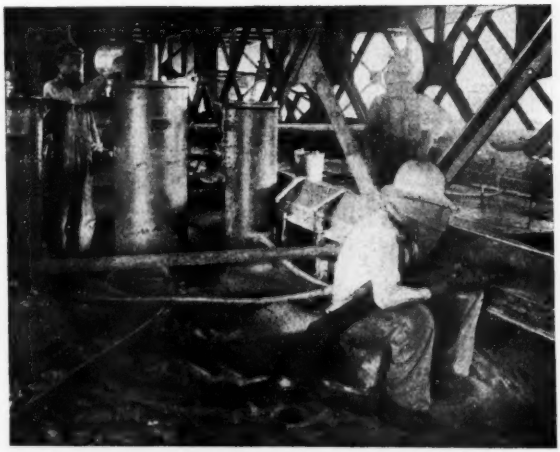

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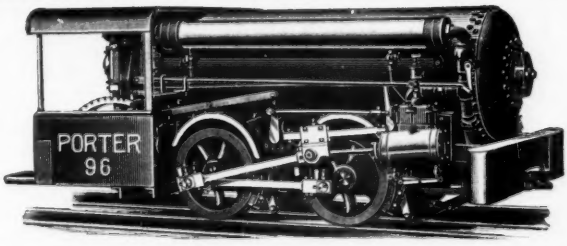

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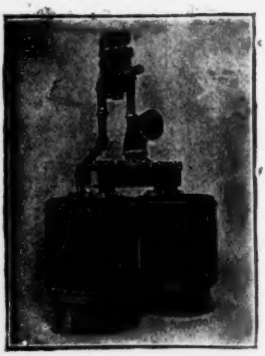

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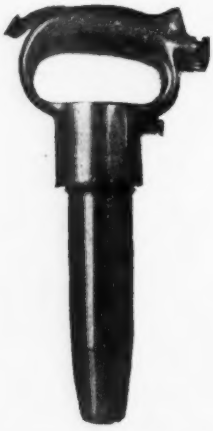

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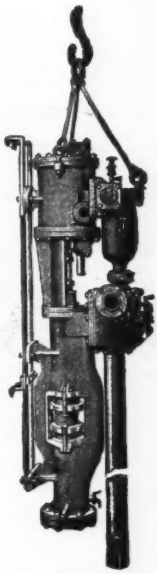

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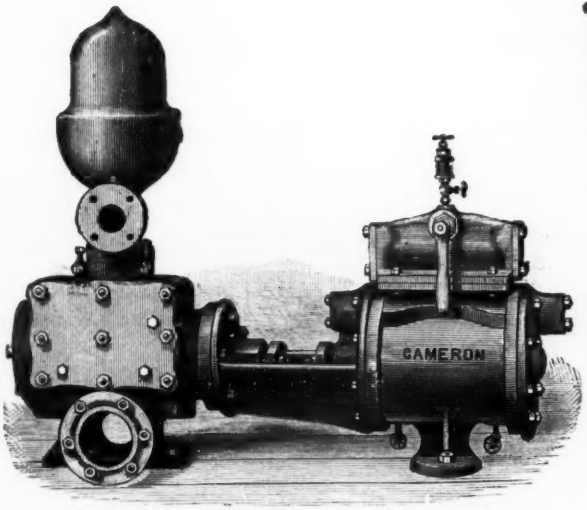

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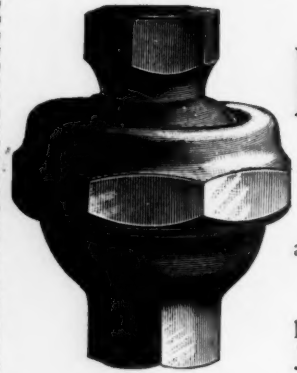

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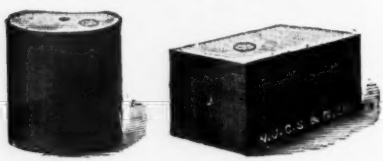

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VOL. IV. JULY, 1899. NO. 5.

We have never been enthusiastic over pneumatic traction. Our readers will recall several publications in this paper containing descriptions of street car motor propelled by compressed air. We have also touched upon the subject editorially, and have always made an effort to watch the developments closely following all designs both theoretically and practically, believing as we always have that ultimately a street car propelled by compressed air would be developed and put into constant practical service.

The June number of this paper contained an original description with illustrations of the pneumatic system which has recently been put into operation in New York City. This cannot be called a new system. It is simply a development based on large experience. Heretofore running street cars by compressed air has been experimental only; that is, one or more cars have been built and run experimental from time to time with a view of attracting attention, interesting capital, with the purpose in mind to equip a road. The most important step toward the solution of this problem was made by the American Air Power Co. when it ran a car steadily for one year on the 125th street line, New York. This was a Hardie car and the results obtained were quite satisfactory. The length of service enabled the engineers of the company to figure closely as to the cost of operation, volume of air consumed, repairs, percentage of grades, etc. In this experiment the total average daily mileage was 125.16 miles, and the total distance covered, 23,000 miles; the total number of passengers carried, 137,386. At that point the car traveled on a grade of 7 7-10% for a short distance. The expense of operation including coal and water items, and all labor, including night-watchman, record-keeper and switchman, for a portion of the time figure about $.26 per car mile. When based on two-car service during the latter period of the experiment the cost was brought down to a little over $.20 per car mile. Mr. Pettee, the engineer in charge, states that if the proportion of labor actually utilized in this service is considered, the expense would only amount to about $.18 per car mile. These figures are all based on the services of one or two cars with an air compressing plant to average economy, and should not be reckoned in comparing with the cost of operating the entire system of street cars of any other power. In fact it is safe to assume that based on this experience a large equipment of cars might be run at an expense of about $.12 per car mile. The Hardie car in this work showed an average consumption of a little over 400 cubic feet of free air per car mile, though at times the consumption was less than 400, and it is not difficult to understand wherein improvements might be made which will reduce this consumption considerably. In fact it is claimed by persons connected with the Air Power Company that the cars of the 28th and 29th street lines will consume only about 350 cubic feet of free air per car mile.

The system of reheating employed on

the Hardie and the Hoadley-Knight cars is from steam and hot water; this adds largely to the economy of air consumption but it cannot compare in efficiency with the dry system of reheating which is likely to be the system adopted for the future. The cost of compressing air up to 2,500 lbs. pressure per square inch is about $.05 per thousand cubic feet of free air when based on plants of average capacity. It is likely that this cost can be reduced and it will be interesting to note the results of a test made on the large air compressor which was described in our June number, and which is now installed at West 24th street, New York, for the purpose of compressing large volumes of air up to 2,500 lbs. pressure. As the cost of motive power is merely but a fraction in the cost of operation in street car services, perhaps from $.02½ to $.03 per car mile would represent the cost of motive power when based on the experience of 125th street, the balance is chargeable to repairs administrations, etc. The item of repairs is an important one and will be watched with great inferest in the 28th and 29th street lines.

Several cars are in regular operation for carrying passengers crosstown in New York, and as they are similar in every respect to the original electric cars they attract little or no attention. The cars are noiseless, free from all odor, and perfectly safe, each car being an automobile, running with its own power and entirely independent of a central connection. This feature is important in cars at service as it admits of running on different tracks, and practically makes an independent automobile 'bus out of the street car.

The plant now running in New York is, we think, without question, the highest type of pneumatic equipment for this purpose which has been brought to our attention. Improvements have been made throughout the system in the air compressor, and in the motors which promises well. There is really nothing very experimental about this plant as it follows closely well established railway practice. The cars are the standard of The Metropolitan Street Railway Company. They are built on the standard Brill truck, air motors being simply substituted for electric motors; the weight of the motor being partially on the car axle, all other parts are mounted on the car body. It looks very much to us as though this plant had been installed to stay. The entire system is so thoroughly modern and the installation so large and at so great an expense that it has the air of permanency, and in fact we look for its development from this starting point to other lines.

Liquid Air

A Plant for the Commercial Manufacture of Liquid Air.

The announcement that within a short time there will be in operation in New York city a commercial liquid air producing plant, with an estimated capacity of some 1,500 gallons of liquid air per day, is certainly a remarkable one, and especially so when it is remembered how short a time has elapsed since the liquefaction of air was first effected, and that up to a couple of years ago or so the liquefaction had only been accomplished on a minute scale in one or two laboratories, and at an expense which made the product almost as costly as a precious metal.

In the issue of Engineering News for April 14, 1898, was given the first technical description of the laboratory and apparatus of Mr. Chas. E. Tripler, of New York city, who was unquestionably the first to produce liquid air on anything like a commercial scale.

Since then descriptions of this laboratory, and statements concerning Mr. Tripler's work of all degrees of accuracy

and inaccuracy have run the rounds of the newspapers and the popular magazines, so that the general public has become quite conversant with liquid air, at least from the spectacular standpoint.

In our article above referred to, and in an editorial discussion of the possibilities of liquid air, published in the same issue, some of the uses and the limitations of liquid air were pointed out. These prospective uses and the great popular interest in the subject, have set a large number of investors and scientists at work in this field, both in this country and abroad.

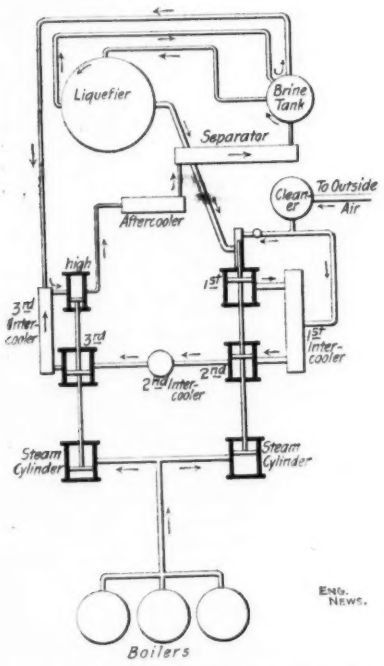


FIG. 1.—SKETCH DIAGRAM OF AIR LIQUEFYING PLANT, SHOWING PRINCIPAL APPARATUS AND PIPING.

By all odds, the most extensive work, however, to the best of our knowledge, has been done by the General Liquid Air & Refrigerating Co., of New York city, whose offices are in the same building as those of Engineering News. This company has been organized to control the inventions of Messrs. O. P. Ostergren and Moriz Burger, relating to the liquefaction of air. It has secured patents in the United States, and in a large number of foreign countries, and it has built and has now ready for operation a plant for the commercial production of liquid air on a scale sufficiently large to demonstrate the efficiency and value of its process.

In the accompanying diagram, Fig. 1, we have represented in symbol the various parts of the apparatus, and by reference to this the operation of the plant will be readily made clear to the reader. It may be said in the first place that in principle the plant is merely a steam-power refrigerating plant, utilizing the expansion of compressed air to produce a low temperature, and causing this cold air to react upon itself, utilizing a different principle, as they claim, from that of the Tripler or the Hampson apparatus, until a temperature is reached so low that liquefaction occurs.

The steam is furnished by three vertical fire tube boilers, of 75 nominal H.P. each. These deliver steam at 150 lbs. pressure to two independent, two-stage horizontal straight line air compressors, built by the Ingersoll-Sergeant Drill Co., of New York city. The one at the left, which may properly be termed the low-pressure compressor, has a 16 × 18-in. steam cylinder, an 18¼-in. low pressure cylinder, and a 12-in. intermediate air cylinder. These are connected by the first intercooler. The large low pressure cylinder is in reality a vacuum cylinder, whose function will be explained later, and in this the maximum pressure is never more than the atmosphere, or 15 lbs. The air leaves the second cylinder at 60 lbs. gage pressure, and passes through the second intercooler to the low pressure cylinder of the second or righthand compressor. This has a 22 × 24-in. steam cylinder, low and high pressure cylinders 7¾ and 7 ins., respectively, in diameter.

The third compressing cylinder delivers the air into the third intercooler at a pressure of 300 lbs., and from it the air enters the high pressure cylinder and is raised to 1,200 lbs. pressure. The air then passes to the aftercooler. In this, as well as in the intercoolers, the operation is simply to extract the heat which has been generated by the compression of the air by passing the air over water-cooled tubes.

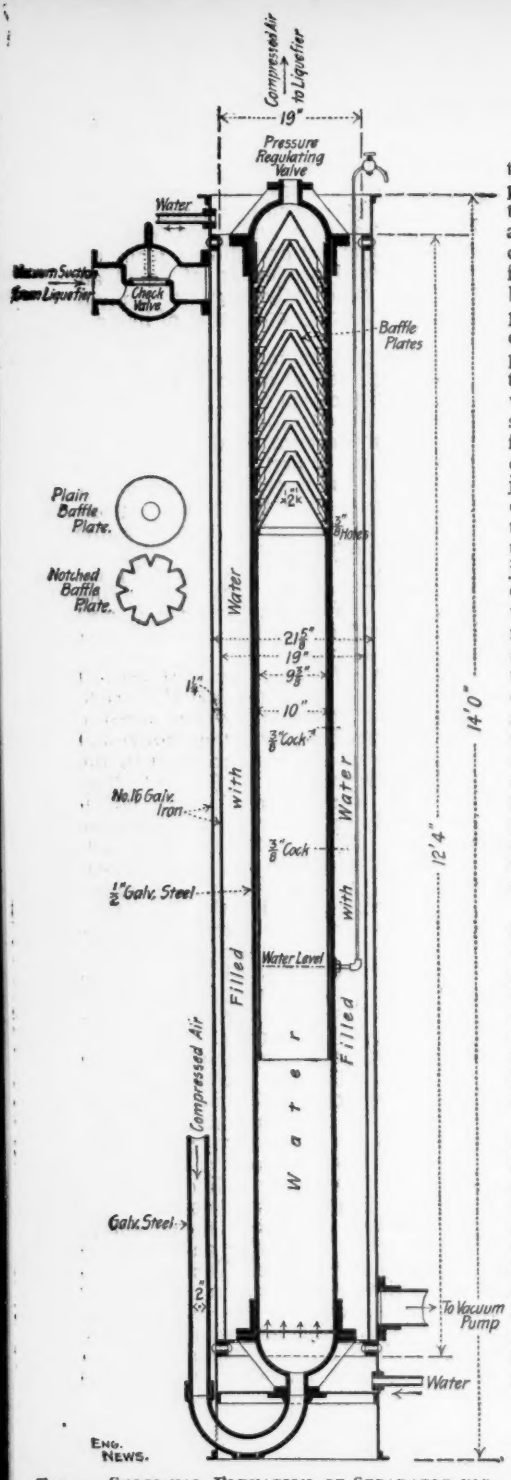


FIG. 2.—SECTIONAL ELEVATION OF SEPARATOR FOR REMOVING OIL AND MOISTURE FROM THE AIR AFTER COMPRESSION.

So far the operation is identical with that of any ordinary four-stage air compressing plant. It is from this point on that the special apparatus for purifying and refrigerating the compressed air comes into play. Continuing the circuit from the aftercooler, the air enters at the base of a tall separator, Fig. 2, whose purpose is to remove all moisture, oil, dust or other impurities from the compressed air, an operation quite essential to prevent the liquefier becoming clogged with ice and grease. As it enters the separator the compressed air meets a perforated disk, which breaks the incoming current up into a large number of fine jets. These bubble up through a column of water which washes the air and extracts from it all grease or other impurities which it may have accumulated in its journey through the compressors, intercoolers and piping. Breaking from the water surface, the level of which can be maintained by means of the blow-off pipe shown in Fig. 2, the air rises towards the top of the separator and strikes a series of conical baffle plates, between which it zig-zags, as shown by the arrows, until the top of the separator is reached. It will be noticed that the alternate plates with open tops have a series of holes in the inner casing which supports all the plates. This arrangement permits the entrained moisture to run back to the water chamber without coming into contact with the rising current of air.

Just beyond the outlet end of the separator is a pressure regulating valve, whose duty is to let the compressed air pass by at a constant pressure, so that it will enter the liquefier in a constant and steady stream. From the far side of this valve a small pipe is carried to the automatic governor of the steam end of the high pressure compressor to insure its proper action.

Passing on the air enters the header of the brine or cooling tank, Fig. 3. The header has an inner tube, which is small enough to considerably increase the velocity of the entering air, and at its lower end is provided with a small inverted conical, nozzle closing receptacle, known as the "supplementary moisture collector." The air passing through the small tube with increased velocity projects into the nozzle any moisture which may have passed the separator, and then passes up between the small tube and the

header. Radiating from this header and winding spirally inward towards the centre of the tank, Fig. 4, is a series of flat coils, all of which terminate in a second header, from which the air pipe leads to the liquefier. Beginning at the centre of the tank and winding outward in the reverse direction, is a similar and duplicate set of spiral tubes which terminate in an outside header. This second set contain the expanded air returning from the liquefier. The principle of this apparatus is seen by referring to Fig. 4, in which it will be seen that the cold expanded air in passing through its coils is in close proximity to the entering compressed and warm air.

Before considering the liquefier it is perhaps well to trace the course of what has just been called the expanded air. In reality this is only partially expanded for it reaches the exit end of the brine tank coil at a pressure of about 300 lbs. per square inch. Referring again to Fig. 1 it will be noticed that a pipe leads to the third intercooler, which has also a pressure of 300 lbs. This arrangement, it will be observed, starts the cleaned and cooled air which has not been liquefied on the circuit again at a point where only a single compression is necessary to put it into condition for supplying to the liquefier.

The principal part of the system and, of course, the one to which the most interest attaches, is this liquefier. For the present let us consider the apparatus without air, as it stands when inoperative.

Its outside appearance is well shown in Fig. 8, which shows the exterior lagging, the entering and leaving air pipes and the valves and gages connected with different portions of the intensifying coils inside.

The liquefier consists of two portions, Fig. 5, the upper and larger or the liquefier proper, and the smaller and lower portion called the aftercooler which contains the reservoir for the liquid air and plays a very important part in the proper working of the system.

Referring now to Fig. 6, it will be noticed that the upper portion is filled with two sets of coils of small copper pipes which, as in the case of the brine tank, Fig. 3, are wound in flat spirals in reverse directions, that is, those for the entering air spirally inward to the central of the header, shown in Figs. 5 and 6, and the other set starting from the outer section of the breaker and spiralling outward to an outside header. However, a fundamental difference exists between the brine tank and the liquefier in the fact that the tubes of the latter are soldered together in vertical rows, thus forming a spiral space from the outside to the inside, or vice versa. In other words, it is as if a solid flat strip of 40 tubes were wound in a spiral. Connected with the space which surrounds both sets of tubes is a large exhaust pipe leading to the suction end of the first cylinder of the low pressure compressor, already mentioned, whose function it is to exhaust the air from this space and the interior of the aftercooler, as will be explained later.

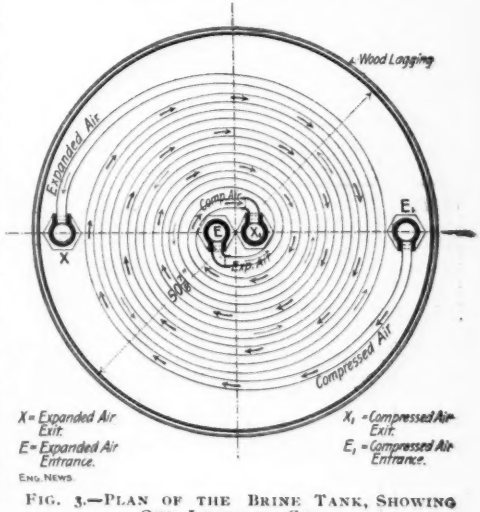


FIG. 3.—PLAN OF THE BRINE TANK, SHOWING ONE LAYER OF COILS.

The aftercooler, shown in detail in Fig. 5, consists of a central chamber closed by a heavy cast-iron inverted cup, resting on a knife-edge turned on the top of the reservoir, and a siphon tube dipping to the bottom of the reservoir, and winding around the cup and cover, and finally emerging to the outside of the supporting casing of the apparatus. This is all enclosed in an air-tight casing which connected to the spiral space of the liquefier, and hence to the vacuum pump.

At the lower extremity of the central header of the liquefier, and at the top of the aftercooler, are two similar valves,

shown in detail in Fig. 5, and operated by separate valve handles from the outside of the apparatus, as shown clearly in Fig. 8.

Having now an idea of the mechanical construction of the apparatus, let us start with the compressed air entering the liquefier, and follow the operation of the several parts. The air, at a pressure of about 1,200 lbs., and a temperature equal to that of the brine tank, say 50 or 60° F., flows into the outside header, and round

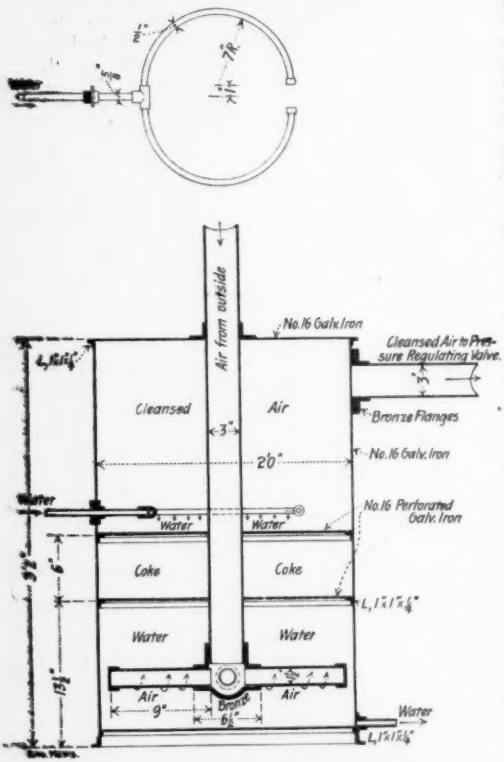


FIG. 4.—SECTION OF THE CLEANSER FOR REMOVING DUST FROM AIR PREVIOUS TO COMPRESSION.

and round through the spiral tubes towards the central chamber, and finally through the expansion valve into the small space below. This valve is so adjusted as to throttle the flow and keep the difference of pressure between the two sides of the valve at approximately 900 lbs. This drop in pressure, and consequent expansion cools the air a certain amount. This cooled air now passes upward in the outer portion of the central header and starts in its spiral course outward, the tubes in which it is confined being in close metallic contact with the entering air tubes. No matter how small the difference in temperature may be, the entering air will in consequence lose some of its heat to the outgoing cooler air, and will thus arrive at the expansion valve at a slightly reduced temperature only to expand and produce a further drop in temperature, which in its turn still further cools the entering air. This accumulative cooling continues until eventually the critical temperature of air is reached. Then, and then only, a portion of the air passing through the expansion valve liquefies and collects in the small chamber over the second or aftercooler, or reservoir valve. That portion which does not liquefy, which is, however, intensely cold, of course passes into the cooling tubes as before.

From what has been said it will be seen that the air once taken into the system is used over and over. There is, of course, need for new air to take the place of that liquefied, and this is drawn in from outside through the cleanser, shown in Fig. 4, and a suitable automatic valve. This cleanser consists of an inlet tube coming from the roof of the building, and extending down to the bottom of the containing tank. From the bottom of the four arms, the air bubbles out and up through water to a coke filter, where it is thoroughly scrubbed. It is also subjected to a water spray, after which it remains in the upper portion of the tank until needed by the system, when it is drawn into the vacuum cylinder.

Returning to the liquefier again, it will be seen that opening the aftercooler valve allows the liquid air to pass into the reservoir below, where at first it will immediately volatilize, owing to this portion of the apparatus being warm. This will produce in the reservoir sufficient pressure to lift the heavy inverted cup and permit the intensely cold air to flow out into the vacuum space of the aftercooler, and thence through the spiral space of the liquefier. At the same time a portion of the cold air will pass through the coiled siphon tube and out the draw-off valve. Soon the parts of the aftercooler become

sufficiently chilled, and the liquid air passing through the lower valve, remains in a liquid state. The heavy cap is so proportioned that there is a pressure of about 6 lbs. per sq. in. on the liquid surface, and this is sufficient to force the liquid air through the siphon tube and out of the faucet. We then have the following condition of affairs:

The reservoir is partially filled with liquid air, as is also the coils of the aftercooler, and the space surrounding the

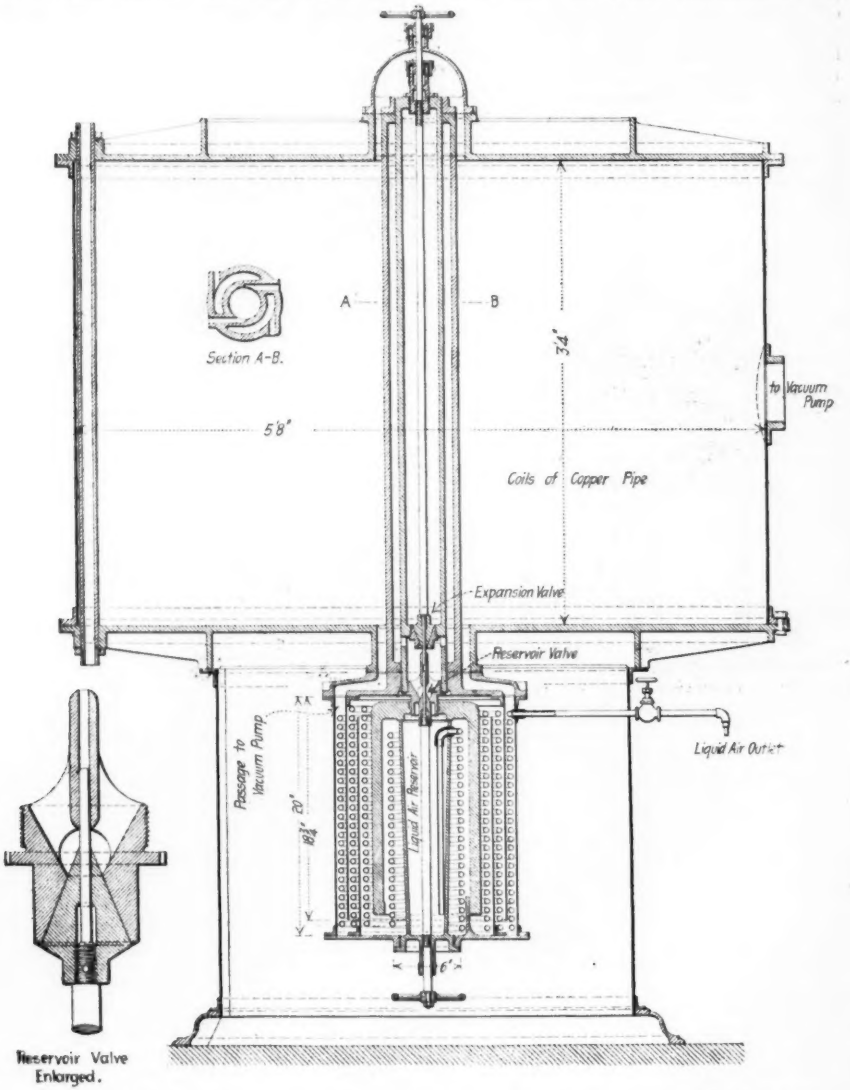


FIG. 5.—SECTIONAL ELEVATION OF LIQUEFIER AND AFTERCOOLER, SHOWING DETAILS OF VALVES. LIQUEFIER COILS ARE NOT SHOWN.

tubes is constantly being exhausted, so that whatever liquid air or vapor air may spill over when the inverted cap lifts is instantly evaporated in and around these filled tubes, thus further reducing the temperature of the air about to be drawn off; the vacuum spiral space surrounding the tubes of the liquefier is constantly having the intensely cold evaporated air passing through it and the temperature of the whole apparatus is therefore being gradually reduced toward some minimum which so far as present indications go is remarkably near absolute zero. In fact, judging from results obtained the first time the plant was

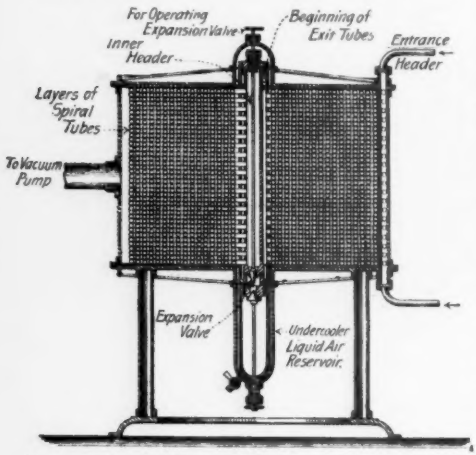


FIG. 6.—DIAGRAMMATIC VIEW OF INTERIOR OF LIQUEFIER, SHOWING PRINCIPLE OF ITS CONSTRUCTION.

operated to test the compressors, etc., it may be expected that air will be actually solidified.

The same test seemed to indicate that the brine tank is superfluous, and it was found that the entering and leaving air and the liquefier casing were at practically the same temperature.

One of the problems to be solved before liquid air can be of any great commercial value is some method of carrying and storing the material so that it can be retained in a liquid form. The company has endeavored to perfect this feature in a practical and business-like way. The results of its efforts is shown in Fig. 7, which represents a 40-gallon reservoir and also illustrates the principle of the larger and smaller sizes. The inner metal vessel is closed, except for a small offset pressure gage tube, and the larger opening constituting at the same time the filling tube and the relief valve. Surrounding this is a second vessel, in its turn surrounded by some non-conducting material such as corn pith, excelsior, granulated cork or the like, contained in a wicker basket. The inner tank being filled with liquid air the relief valve automatically opens slightly from time to time, as the pressure exceeds about 6 lbs., and permits the escape of the cold air into the space between the two metallic tanks. This forces the warmer air out through the bottom of the tank and maintains a very cold blanket of air between the liquid air and the exterior insulating casing; smaller and cheaper forms are made by using an open inner vessel made of wood pulp similar to the well-known one-piece water buckets. These are surrounded by wire netting held away by small wooden strips.

The vessel is then put in a wicker basket, packed about with some insulating material as in the former case, and is provided with a wooden cover which rests on the wire netting and forms an air space.

Still another form consists of two metallic spheres, between which is a third molded cork sphere held away from the others.

Both the inner and outer spheres are provided with separate relief valves, so that when the pressure exceeds a certain set amount the inner valve lifts and, one might say, exhales into the space between the inner and the cork spheres. The cold air gradually works outward through the cork, becoming warmer as it progresses. Finally it reaches the space between the cork shell and the outer metal casing and accumulates until the pressure is sufficient to lift the second valve when it passes into the surrounding atmosphere.

While the company has devoted its chief endeavors to the process of liquid air manufacture and transportation, it has also paid some attention to the possible applications of liquid air. One which is of especial interest in these summer days is the operation of a cooling fan by compressed air obtained from volatilizing liquid air. The liquid is held in a suitable receptacle, while a coil connected with

this receptacle constitutes a vaporizer and heater utilizing the heat of the atmosphere. The fan is revolved by a small turbine driven by the air under pressure, which, as it escapes from the motor, is caught by the fan blades and whirled forward in the current of air. In this way not only is the air in a room kept in constant motion, but it is continually cooled and freshened by the addition of the cold exhaust air of the motor.

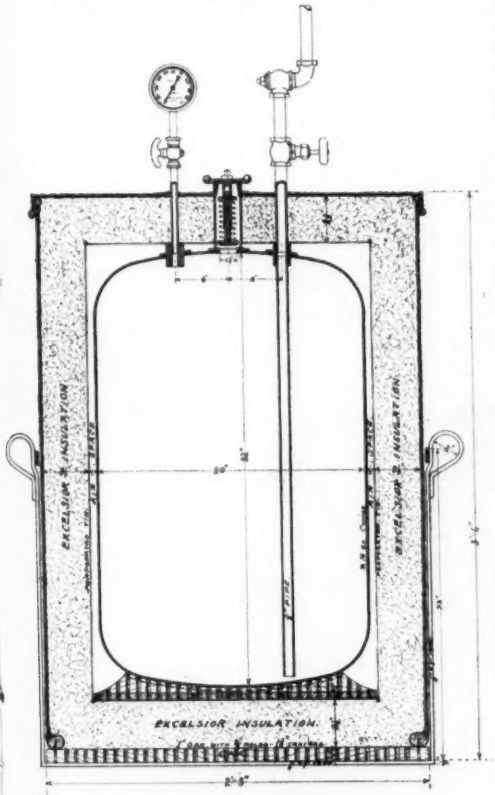


FIG. 7.—SECTION OF LARGE SIZE RESERVOIR FOR CONVEYING AND RETAINING LIQUID AIR.

To our readers who have followed the above description of the air liquefying process, it will be apparent that its efficiency, or the quantity of liquid air produced for a given expenditure of power, depends primarily upon the amount of refrigeration which is effected in the expansion of the air through the contracted orifice of the expansion valve from a pressure of 1,200 lbs. to a pressure of 300 lbs. The cooling which is effected in such an expansion from ordinary atmospheric temperatures, when the expansion takes place in a cylinder against a piston, is, of course, known with fair accuracy; but what the cooling may be when the expansion occurs through a nozzle and the jet of air at high velocity performs more or less internal work which tends to restore its original heat, is something as yet unknown, and which can only be determined by careful experiment.

Such preliminary tests as have been made with the above apparatus, however, indicate that the refrigeration due to the expansion under the conditions existing in this apparatus, is much greater than such empirical formulas as have been heretofore relied upon have indicated. The results of complete and accurate tests to determine the product of liquid air per horse-power hour in this apparatus will therefore be awaited with interest.

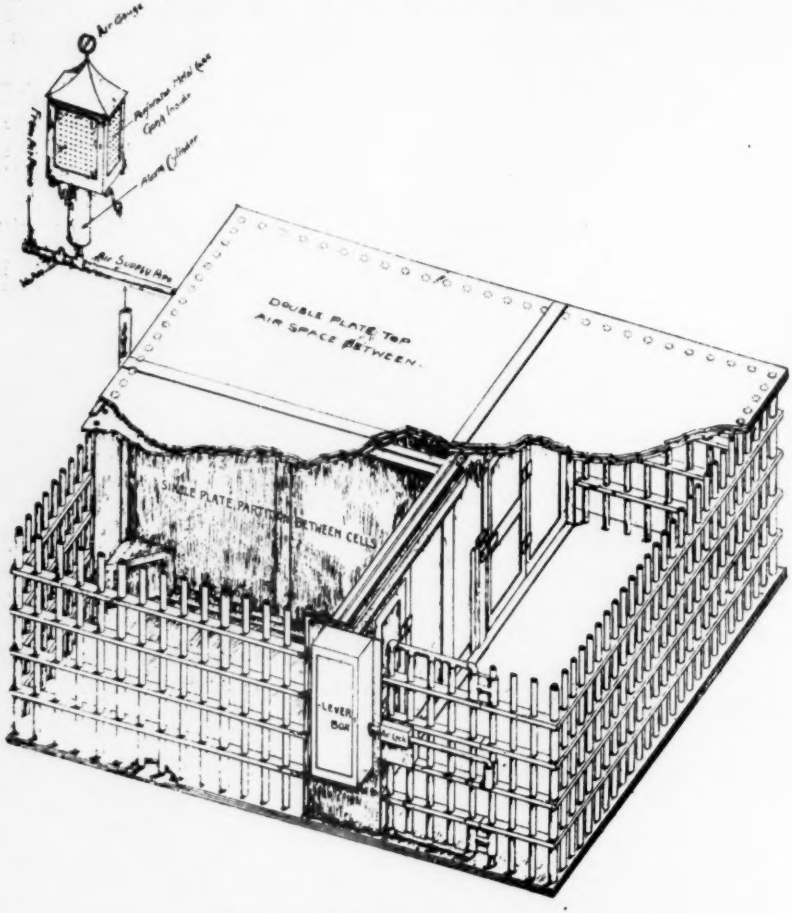
For the material from which this description and the accompanying illustrations have been prepared, we are indebted to Messrs. O. P. Ostergren, President and Engineer of the General Liquid Air Co., and S. M. Gardenhire, Esq., its Secretary.—Engineering News.

Miscellaneous Applications of Compressed Air

Something New in Jail Construction.

The "Pneumatic Safety Jail" is the significant name given to the latest design of steel jail cell recently perfected by the Pneumatic Safety Vault and Jail Co., of Chattanooga, Tenn. The inventors believe they have attained a greater degree of safety and security than is afforded by any other design of jail made, and, as the word "Pneumatic" would suggest, part of the means employed is compressed air. If the jailor has timely warning that the lock or door is being tampered with, or any of the cell bars are being cut or filed, he can always take measures to frustrate the intended escape. To give this sure warning before any material damage can be done is the part compressed air plays

in the new jail. The following description will convey an idea of its principal features of construction. The exterior walls of the cells are constructed of vertical tubes with hard tempered steel cores, spaced about 4½ inches between centres. The floor and ceiling are of double plates with an air space between. The horizontal bars through which the verticals pass are square in section and contain a small air pipe continuous all round the outer cell walls. An air pressure of 15 or 20 lbs. is maintained by a pump placed at any desired point in the building, the supply pipe connecting it with the air spaces of the cell being built in the walls of the building or otherwise protected. In small jails the pump is operated by hand and in large ones by electric or water motor or other available power. An automatic alarm, set to ring when the pressure falls to say 5 lbs., gives timely warning when any of the air spaces are pierced or connections broken. As may be readily seen the alarm can be placed at any desired point, either inside or outside the jail building, or any number of alarms may be used. It may be



JAIL CELL PNEUMATICALLY PROTECTED.

conveyed to any distance by electricity or by air pipe, but the objection to relying on an electric alarm is that it may be so easily tampered with. There is no tampering with compressed air. An accidental loss of pressure, an injury to the supply pipe, any defect in the system must set off the alarm. The door is built up of tubes and receives the air pressure through tubular hinges or through a union near the lock, which must be disconnected to open the door. A flat lock of the Yale pattern is used, and as an additional safe guard it is protected by an "Air Lock," which consists of a hollow hinged bar containing air pressure swinging across the door and face of the lock. This must be removed, thereby breaking the air connection and sounding the alarm, before the lock can be gotten at. The cores of the vertical tubes spoken of above are octagonal steel about ⅞-in. diam., tempered to be as nearly tool proof as such metal can be made. They are pivoted at the ends so they can turn loosely inside the tubes. The object being to give additional strength to the tubes, and in case of the air pressure being off for any reason, to make what the inventors believe to be a jail fully as difficult to cut out of as any of the best designs now on the market. It would be almost an impossibility to saw or file through a bar built up of an exterior tube with a hardened steel core loosely fitted, that would turn with every stroke of the saw. And again, the temper of such a bar could not be drawn by any means available to a prisoner. Cases are numerous where the best so-called tool-proof bars have been softened so as to be easily cut, by what would seem to be the most simple means, unthought of by any one except a prisoner whose sole mental and physical effort is to get out, such as a blow pipe made of a common pipe stem and a candle allowed him by the leniency of the jailor, the one to read by and the other to smoke with; or piping gas across the cell to the desired point by a tube moulded of bread crumbs, etc. Shrewd criminals study the question of how to get out of jails just as the builder studies how to keep them in, and the contest is close between them. It is like the contest between builders of war ships and makers of cannon, the one with his armor-piercing projectiles and the other with projectile-proof armor. It is an undisputed fact that unless closely watched even ordinary prisoners will find means to get out of the best built so-called "tool-proof" jails. We have but to watch the daily press reports to find numerous instances. In one of the most recently built state penitentiaries which has been finished scarcely two years, at least two escapes have been reported by cutting supposed tool-proof bars. Very recently a jail escape was reported in a prominent town of one of the Eastern States that is in itself a unique example. Two prisoners cut the bars of their cells and laid in wait at night in the corridor for the one turnkey who was on duty. As he made his rounds they sprang upon him, bound him and left him helpless. Then they robbed the office safe of the jail of $2,500.00 belonging to various officials and prisoners, supplied themselves with revolvers and ammunition and made their escape. The manufacturers of the pneumatic safety jail believe they have introduced the only real improvement in jail building which has been made since the introduction of "Chrome" steel or of bars made up of layers of hard and soft metal rolled together. They have adopted the word "Safety" across a U. S. shield as a trade mark and believe it fully merited. Before offering to build jails for public use they have experimented extensively to find what mechanical difficulties had to be overcome to carry out their ideas. They have now a full size cell complete in every particular in their shops at Chattanooga. The principals involved and details of construction are fully covered by patents. Those principally interested in the enterprise are the Casey & Hedges Mfg. Co., of Chattanooga, well known manufacturers of boilers and machinery, and Linn White, an experienced civil and mechanical engineer, who will have charge of the business of the company.

A New Gas-Pressure Generator.

For Increasing the Efficiency of Compressed Air for Traction Purposes.

The invention relates especially to pressure generators of the continuous-combustion type, whereby a greater amount of heat is saved and converted into a useful working pressure than has hitherto been possible.

The objects in view are to provide a

simple and instantaneous internal-combustion pressure generator where gas or oil vapors or other like rapid combustibles are burned in the retort or combustion chamber with the proper amount of air to form perfect combustion. The burned gases thus formed pass out of the combustion chamber, where they unite or commingle with steam that has been generated in the coils that surround the inner walls of the combustion chamber and pass from the combination to the mixing chamber. The steam issues from said pipes as "saturated" steam and, commingling with the burned gases, forms "superheated" steam, which is used expansively or otherwise in any desirable form of engine, whether it be a reciprocating, oscillating, rotary or steam turbine, but preferably in the latter.

A further object of the invention is to provide an elastic motive fluid having the advantage of both gas and hot air and also steam without their disadvantages—namely, the tendency which gas and hot air have to destroy the sensitive parts of an engine and also the rapid falling off of the pressure—since by the addition of steam the expansive qualities are prolonged and act more as a lubricant than as a destroyer of the lubricating agent.

1 is the combustion chamber, having an opening or neck 2, leading into the mixing chamber 3, both forming compartments within the interior of a proper casing A. Through the bottom of the combustion chamber passes an induction pipe 4 and is made to form a coil and lining B for the retort or combustion chamber, leaving an opening at the center of the coil for the injection pipe 5 to pass through. Then this pipe 4 continues coiling around the inner walls of said chamber until it reaches the crown sheet C, where it also lines the same by being properly coiled, leaving an aperture in the center thereof, so as to not obstruct the passage 2. From thence said pipe 4, after lining all the inner walls or surfaces of the combustion chamber, continues to make a series of flat coils 6, that are suspended within the upper portion of the chamber 1, and finally said coils end by turning up and passing through the central passage of the flat coils 6 and through the neck 2 into the lower end of the mixing chamber 3, being held in position by a suitable bracket 7, through which it passes, and is secured by a nut 8. The bottom of the mixing chamber 3 is made within a convex head, consisting of the crown sheet C, in order that the water of condensation may be

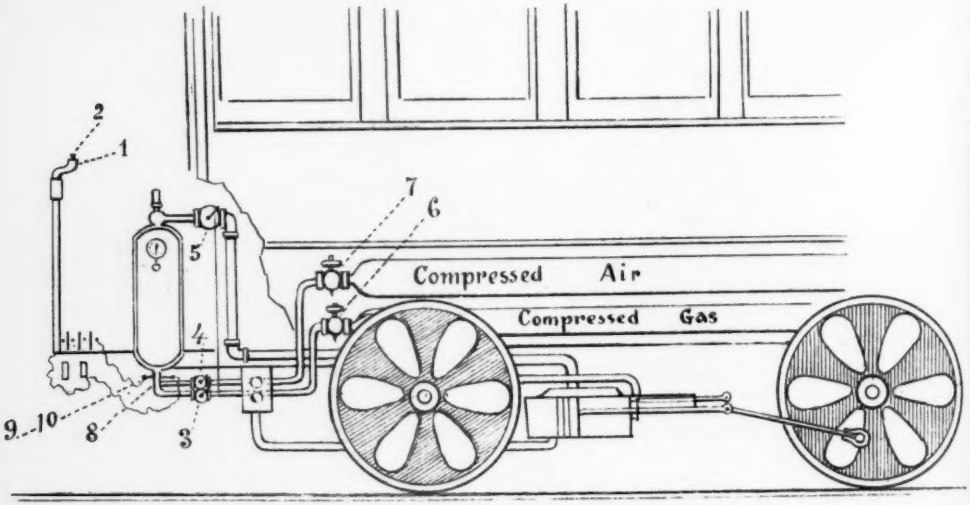


FIG. 1.—MOTOR CAR WITH GENERATOR IN POSITION.

drained therefrom by the cock 9. The object of providing the two chambers 1 and 3 with a flared-neck tube between them is to keep the combustion chamber 1 clear of any steam or moisture, so that only pure air is present to form perfect combustion in combination with the gas or oil vapors. After the products of combustion have passed through the neck 2 into the mixing chamber 3 and have commingled with the steam issuing through the nozzle 10 they then pass out through the eduction pipe 11 to the motor or other suitable point.

Fig. 1 is a sectional view of a motor car, showing the generator in position.

The mode of operating cars that have a central station where air and gas are compressed and then delivered to the individual cars as they come in to be recharged, is as follows:

First recharge the air and gas tanks under seats of cars. Then to start cars pull lever 1 forward gradually, thus opening simultaneously the gas valve 3, the air valve 4 and the throttle valve 5. Valves 3 and 4 receive air and gas in proper proportion from their respective tanks through the pressure reducing valves 6 and 7, through independent pipes, until they reach the burner 8, where they unite and are fired by an electric spark between electric electrodes 9 and 10, and produced by pressing the push button 2 with the thumb, at the same time the lever 1 is pushed forward. At the instant the motor starts it pumps water automatically to the steam generating coils located in the combustion chamber of the generator. Thus the working fluid passes out of the generator through throttle 5 to the motor and starts cars.

When it is desired to stop cars, push hand lever 1 backward; this action closes all three valves, viz., air, gas and throttle, at same time cutting off working fluid supply, thus stopping motor.

Fig. 2 is a sectional view of the rear end of a horseless carriage, showing the generator and motor in position.

In this instance it will be seen that the compressing station is dispensed with.

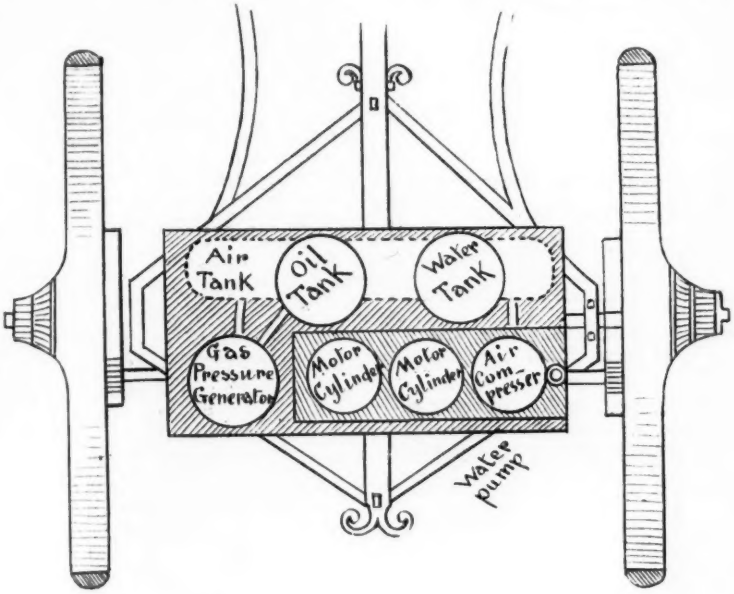


FIG. 2.—REAR END VIEW OF HORSELESS CARRIAGE.

As the plant is "self-contained," the motor doing its own compressing of air and delivering same to a supply tank on board. Said supply air tank is connected by a by-pass to the oil tank (kerosene or gasoline), in order to have the same pressure on top of the oil in oil tank as there is in the air tank, thus feeding the air and oil in proper proportion to the burner at equal pressures.

The oil is first converted into a "fixed gas," "before" it commingles with the air, by a new gas generating burner (not shown here), also invented by Mr. Woillard recently.

The inventor of the above system is endeavoring to secure financial aid to put his invention upon the market.

Interested parties can learn more by addressing the inventor himself.

Air Brakes

Appliances for Repairing Hose and Forming Pipes.

There is illustrated in the following engravings some compressed air appliances for bending pipe, hose testing and other

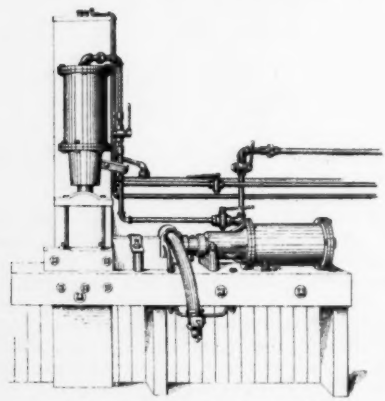


FIG. 1.—MACHINE FOR APPLYING HOSE FITTINGS.

purposes, especially useful for doing the work on air hose and pipes connected with the air brake system and they are used in the shops of the Atchison, Topeka and Santa Fe Railroad at Fort Madison, Iowa:

Fig. 1 is a view of the cylinders that are used for putting the couplings on the hose connections. The vertical cylinder has a clamp attached to the piston by means of which the hose may be firmly held in position while the coupling is being forced into it by the horizontal cylinder. The piston of the latter is arranged with a head of such a form that the coupling fits into and is held by it while being forced in. This type of apparatus is in common use elsewhere.

Fig. 2 is a device for testing all second-hand hose that have been spliced or repaired, before they are again put into service. The arrangement consists of two air cylinders of different diameters. The larger one is at the top, and the pistons of the two are connected by a single rod. The hose to be tested is attached to the one at the bottom, which is then filled

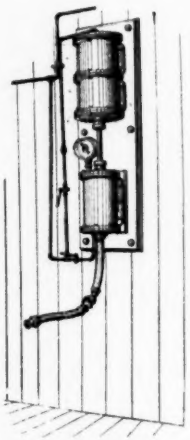


FIG. 2.—HOSE TESTING MACHINE.

with air to the full reservoir pressure. The inlet pipe to this cylinder is then closed, and that to the upper cylinder is opened. The difference in the diameters of the two cylinders causes the pistons to move down, with the result that the pressure in the lower cylinder is increased. A gauge attached to the bottom cylinder permits the operator to know the exact

pressure that is being applied to the hose. This pressure is regulated to be 100 lbs. per square inch.

Fig. 3 illustrates a group of air cylinders that are used for a variety of work. The cylinder at the extreme left of the engraving is used for miscellaneous jobs. A variety of forms and clamps are used to be attached to the piston rod according to what will have to be done. As illustrated, the piston rod carried a knife for cutting good pieces of hose from the damaged portions. These good pieces are then spliced together by the use of malleable iron nipples and clamps. With other formers provided for this cylinder ⅝-inch branch pipes are bent, as well as goose-necks for whistle hose. U-bolts for brake hangers and union gaskets are cut from old rubber.

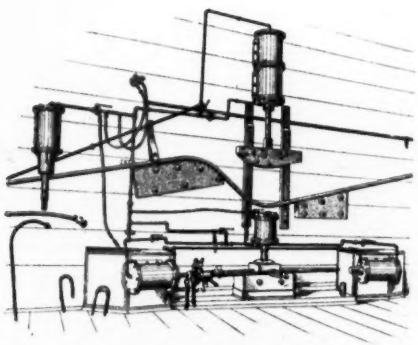


FIG. 3.—PIPE-BENDER AND BRAKEBEAM MACHINE.

The high cylinder placed toward the right of the engraving is used for bending train pipes. This is done by means of two wooden formers located as shown below and to the right and left of the cylinder, which serve as a sort of base or anvil, while the former is attached to the piston rod, and is forced down by the air bending the pipe into the shape that is desired. This is done cold, of course, and the exhaust from the cylinder is conducted to the end of the pipe, and serves to blow out the dirt that may have accumulated, as well as the scale that may have been loosened by the work done on the pipe.

The three cylinders at the bottom are for setting up the hollow brake beams that are used upon the road. These beams are known as the Player type. The cylinder at the center is used for clamping the fulcrum firmly in position while the pipes are being pushed into it by the pressure in the cylinders at the sides. The brake-heads are then put upon the pipes in the same manner. These cylinders are so arranged that they will work air in both directions, and each cylinder can be operated independently of the other or both at the same time, as may be desired. Brakebeams that come in for repairs are placed in this machine and pulled apart, so that new sections may be applied to take the place of those that have been damaged.

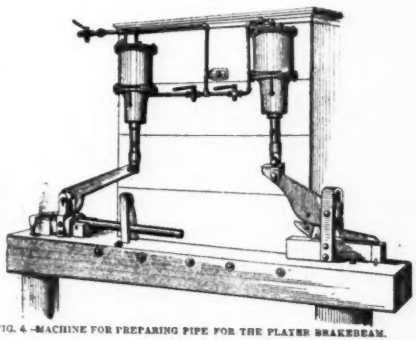


FIG. 4.—MACHINE FOR PREPARING PIPE FOR THE PLAYER BRAKEBEAM.

Fig. 4 illustrates two air-cylinders conveniently arranged for preparing the pipes for use in the brakebeams. The cylinder at the left operates a punch which cuts out a recess to receive a boss, or lug, in the fulcrum, which prevents the pipe from turning after it has been placed in position. The cylinder at the right operates a die that crimps or concaves the other end of the pipe, and which allows the truss-rod to pass through the heads.

We have adapted the above from correspondence of Mr. B. G. Miller, foreman of the air brake department of the Fort Madison, Iowa, shops and which was published in the Railroad Car Journal.

Air Jets

The Ohio State hospital at Massillon, O., use compressed air for their pumping plant. The compressor in use is designed to furnish 344 cubic feet of free air per minute at pressures of 80 to 100 lbs. The air plant has a capacity of about 400 gals. per minute, and a lift of 150 ft.

A tool that is much appreciated in the blacksmith shop of the C. R. I. & P. R. R. at Chicago is a home-made pneumatic hammer for framework. For this work it is considered more convenient than would be a suitable steam hammer, as there is so much more free room in which to handle the frames.

Compressed air played an important part in the raising of the Reina Mercedes. The service was rendered by pneumatic tools; over 300 holes were drilled under water.

A portable air compressor is made by the Christensen Engineering Co., Milwaukee, Wis., and it is now used in supplying air for riveting the structural iron in the new post office building in Chicago. Electricity is used for operating it. It weighs 1,400 pounds mounted on a truck and may be drawn around by a man. No water jacket is used and it is said that it will run half the time without undue heat. The motor and compressor are enclosed by a wooden box covering.

A neat portable air motor is in use at the Corning shops of the Fall Brook Railroad, which was devised by Mr. Williams, the foreman of the shops.

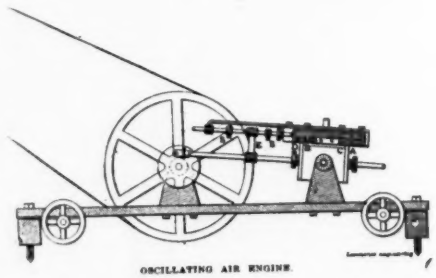
It is mounted on a tripod, and the air inlet is through the small hose at bottom. There are three small cylinders set at 120 degrees and getting air from a ring of pipe. The gearing is contained in a case, from which the flexible shaft is driven. It is a very handy device, as it can be taken to any part of the shop and used where wanted.

Mr. J. A. Eisenaker, of Elmira, N. Y., is responsible for the following, which appeared in Locomotive Engineering:

"I send you sketch of a small engine, driven by compressed air, which is designed for driving boring bar, for boring out locomotive cylinders, or a small lathe or planer, in case of necessity.

The bed plate rests on four wheels, so it can be easily moved wherever wanted. Two blocks are put under the bed plate and fastened to the floor. After being put in line with pulley on boring bar, the air hose is connected and the engine is ready for operation in either direction.

The full air pressure follows the piston to or nearer its dead point ,and can be run to most any speed. The valve is very



OSCILLATING AIR ENGINE.

simple in construction—is a square piece of cast iron (length according to length of cylinder); the ports for taking or releasing air are drilled with a ¼-in. drill, also ports B and C in cylinder, and A and D outside of cylinder, for release.

The valve is surrounded by air; a couple of holes are drilled through top of valve, to let air in to the inner part of valve XX.

It will be seen that the air chest is cast on cylinder and projects over both ends of cylinder, and the air-chest cover is fastened on with top bolts.

The valve-reversing arm E causes the movement of the valve, and is regulated by set screw collars SS, to the required stroke of valve, which will be somewhat cushioned, and also the piston, when same comes near its end of travel.

The piston rod extends through back end of cylinder, and on its front end is directly connected to the crank pin, which of course gives the oscillating movement."

The city of Camden, N. J., owns its own system of water supply. The disposal of sewage in the Delaware River from adjacent towns caused the water of that stream to be objectionable. The water is now taken from driven wells, and the system has a capacity of 20,000,000 gals. every 24 hours. The wells are arranged in four (4) groups surrounding the pumping station, three (3) of which are operated by pumping and one (1) by compressed air. Three of these groups of wells are close to the pumping station, and the fourth group is located over 4,000 feet from the pumping station. This group consists of ten wells 8 and 10 in. in diameter. They are operated by compressed air under a pressure of about 47 lbs. per square inch. The air is furnished by an Ingersoll-Sergeant compressor having a steam cylinder 18 inches in diameter, an air cylinder 22 inches in diameter and a stroke of 22 inches. The receiver is 10 ft. 6 in. long and 4 ft. 6 in. in diameter. The air is conducted from the receiver to the wells through a pipe 7¼ in. in diameter, decreasing to 4 inches at the last well. The air pipe down each well is 1½ in. in diameter with about 60 per cent submergence, and the air escapes through holes in the lower portion. At the head of each well is a broad quarter-bend connecting with the main discharge pipe, and the air pipe passes into it through the flanged shoulder.

Mr. John Pew & Son, Producers and Wholesale Dealers in Fish and Importers of Salt, at Gloucester, Mass., are interested at the present time in the cost of producing compressed air for ventilating purposes, and want to know the capacity of pumps and reservior required. Perhaps some of our readers are familiar with this subject and can give some practical advice. It will be appreciated.

The successful culmination of three important propositions of compressed air within the past month rendered it possible to embody an account of each of them in "Compressed Air." The first in importance is that of the installation of the air plant for the purpose of operating street railway cars. The next is that of the plant of the General Liquid Air & Refrigerating Co., for making liquid air, and the third is the plant for ringing the chimes of St. Patrick's Cathedral. All of these achievements have been accomplished in New York City, and under the eyes of the most critical engineers of the country. There are many notable points of excellence in all of these systems. They are in advance of all other processes to secure the same result. Each of them have in their history the elements of permanent success, and each of them, too, are the outcome of the conservative application of engineering genius. The first opens a field in transportation. It is an object lesson for the world's instruction, a triumph of modern mechanical skill. The second marks a happy epoch in its own field, and that is the ringing of chime bells.

The liquefying plant produces liquid air in large quantities, with a degree of economy unheard of before. Its future is beyond the ken of man.

The picture is one beautiful to behold.

A correspondent of the National Engineer asks the following question:

"Can you give me a rule to find the size of air compressor and pipes to operate an air lift to raise about 2,500 gals. of water per hour from a depth of 300 ft.; the hole is 6-in. diam. and it is 100 ft. to the surface of the water; the water is lowered 25 ft. by pumping at the rate mentioned.

"J. T. B."

This is the reply:

"This well would require a 5-in. casing and should be piped to twice the depth of the surface of the water from the top of the well when the water is at its lowest point, that is at twice 125, or 250 ft. The air pipe should be 1-in. diam. in the well and the pipe between reservoir and well should be 1¼-in. to 1½-in. Steady pumping will depend on the air pipe and the casing being properly proportioned, for if the air pipe be too small, or the casing too large, the well will blow. It will be well to have ample reservoir capacity. Air supply to compressor should be as cold as can be obtained, for then the compressor capacity will be greater than with warmer air supply. The reservoir pressure should be about 100 lbs. (250×.434). The compressor should have a capacity of about one cubic foot of atmospheric air for each gallon of water to be raised."

Instead of blackening dry sand moulds by hand with a swab a compressed air sprayer is now used. It is easily handled and by its use the blackening is thrown into the pores of the sand and into the pockets and corners almost inaccessible with the swab. It is much quicker than the swab and the coating is more uniform.

COMMUNICATIONS.

Under this heading will be published inquiries addressed to the Editor of COMPRESSED AIR. We wish to encourage our readers in the practice of making inquiries and expressing opinions.

We request that the rules governing such correspondence will be observed, viz., all communications should be written on one side of the paper only; they should be short and to the point.

Paris, May 14, 1899.

Editor "Compressed Air:"

I have been just now reading in your Vol. IV. No. 2 of April, 1899, an interview of Mr. Abdank, which was taken by an "Evening Post" reporter.

Before discussing this subject, I must remark that Mr. Abdank, who is in the "Societé Française de Procidis Electriques Thomson-Houston" in Paris, has never had anything to do with the mechanical traction applied to tramcars and overall to pneumatic traction. Therefore, it must be admitted that his authority on the subject is discreditable and his assertion that in France the problem is definitely solved by the adoption of the trolley electric system and pneumatic tramway practically discarded, is the best proof that he is not very well acquainted with the subject he is treating, and the best proof is the Paris Compagnie des Omnibus, the most important of the French companies, who has given a fair trial to all kinds, has pneumatic cars on different lines, and is now building a new station of 5,000 horse power with air compressors, and has enlarged the number of its pneumatic cars from 100 to 250.

As may be therefore easily understood, Mr. Abdank takes his dreams as facts.

Reviewing the technical part of this interview, we must again remark that he is making another mistake when saying: "The compressed air system involves a larger number of transformations of energy than the electric system." Although Mr. Abdank is described as an eminent consulting engineer, we must confess that after having read this part of his interview, we would not care to consult him on the subject; the reason is: Compare both systems and you will find that they require for the initial transformation:

Steam boiler and dynamo for electricity; steam boiler and compressor for compressed air. No difference, no more complication in one case than in the other.

The net loss practical of energy in the compressor is of less than 10-15%, the loss of the dynamo is wholly equal. Again no difference

I may claim that, having built and established in Paris, 1st. 8,000 H.P. of compressed air works; 2d. 10,000 H.P. of electric works, for distribution of light and energy throughout the city, I know and perhaps am the only one who knows that the loss in initial transformation is about equal in both systems. Proofs at disposal.

The distribution is afterwards obtained 1st, by condensation for compressed air; 2d, by cable for electricity. There the advantage remains entirely for different reasons with the compressed air.

Cost of canalisation is smaller (50%) loss of energy, lessened smaller resistance.

The trolley system necessitates as many miles and yards of cables as there are of lines.

Compressed air does not necessitate any canalisation if the line is of less than four or five miles, or if longer, it does not necessitate more than one-half the line or even less.

The compressed air motor car line has another advantage, viz.: Each car carries its own power with itself, and therefore the service is not liable to be totally interrupted all at once, as has often been the case when one serious accident happened on the line or to the cable of the trolley. The proof is: The works I have erected in Paris in 1880 have at present a canalisation of 180 miles, distributing energy to 2,000 H.P. lifts, etc., in 2,000 houses and winding 7,000 public and private clocks, and since 1880 there has never been an interruption of this public service which was worth mentioning; nor has there ever any serious or even light accident occurred in the works or

on the streets, or in private houses, and the compagnie have never paid damages to any one for that reason. Proofs at disposal.

Can Mr. Abdank say the same of the trolley, cable and electric works?

About the complication of the motor, I may say that the 50 moving parts of which Mr. Abdank speaks do not exist anywhere else than in his imagination, and I wish to add that in my works in Paris I have compressed air motors which for 15 years have never been out of order for more than a few hours, necessitated by minor repairs.

The fact that the cost of repairs is not larger, and in fact much smaller on compressed air cars is that, as before explained, the Paris General Omnibus Co. has ordered 150 new pneumatic cars for running our lines. Although this company uses all kinds of systems used in Europe.

To sum up: Against the interview of the prominent consulting engineer, Mr. Abdank, there is the official report of Mr. Hetier, Chief Engineer of Paris and Seine department, whose authority on the subject cannot be discussed.

Extract of report of March 19, 1896, on compressed air tram cars.

"Their auto cars can easily draw one or more carriages attached to them, and therefore carry 100 to 150 passengers at a time, and this even on difficult lines. Their employ in the very centre of Paris on the "Coeurs de Vincennes-St. Augustine" line, where the circulation is extremely intense overall in the Rue de Lafayette and around the St. Lazare railway terminus has not brought to light any serious inconvenience.

These cars are clean, noiseless and do not emit any steam, smoke or odorous gas.

They run over the difficult parts of their track at great speed and with the greatest ease, owing to their reserve of compressed air, which allows them at any moment to give an exceptionally large effort.

To sum up, experience proves that this system of traction is a good solution of the mechanical traction of cars in towns and suburbs.

Signed Hetier,
Engineer in Chief du Department de la Seine.

Mr. Abdank, in his substantial interview, insists upon explosions which he has seen. "Of course he does not speak about the number" of deaths brought by the trolley, cable, at 68,700 volts tension. But then, he makes another mistake. Mr. Abdank has never seen any explosion arising from compressed air, but he may have seen explosions of the steam boiler employed on the McKarsky trams for the purpose of heating the compressed air (what in my mind is a mistake) and which do not exist on my cars or on any of the motors I have built and patented. He cannot have seen any compressed air explosion in France, because there never was one, owing to the fact that the air tanks are subjected to trials (every 10 years) with 33 per cent. suppression and that (contrary to steam boilers) their contents do not alter their intra structure to any extent.

I am willing to prove to this Mr. Abdank with my own tramcars on any line in Paris he might choose that: First, the mile car cost will not be larger than the overhead trolley; second, that it will be much cheaper than the underground trolley and ammutator cars; third, that the cost of the engines and works is very much cheaper; fourth, that the compressed air is after all very much less dangerous than electricity.

Because they have had lately the greatest financial success (owing to the fact that American money was behind them) the electricians believe and try to make others believe that they are alone in this world, and that they surpassed by far all others. It is going a little far in a wrong way.

There is room in the field of industry for all of us.

We shall have our turn, and then let me tell you that the day we shall be on equal financial terms with you the battle will certainly be short and decisive, although perhaps not with the result you would like. Victor Popp,

Engineer, founder of the Cie Rue de la "Air Comprime System Popp."
Commissionaire of the Ville de Paris for Distribution of Energy and Light.

June "Compressed Air" received and it is without question the finest issue yet published. M. S. Harlow.

Boston, Mass.

Elizabeth, N. J.

"Compressed Air:"

The beautiful cover of this month's issue of "Compressed Air" does you the greatest credit and I heartily congratulate you upon the production of such a work of art. Wm. Cox.

Cleveland, Ohio, June 16, 1899.

Compressed Air:

In our judgment the June issue of "Compressed Air" is one of the most representative publications we have ever seen. What a husky young giant compressed air, both the fluid and the magazine is getting to be. The range of subjects treated upon indicates strikingly the progress in the art. Starting with a most readable article on the handling of church bells, touching on one of the most interesting engineering developments of the age; next, for transporting passengers, some of the time we hope within sound of those bells. Next making a broad step into the marine industries showing where compressed air is taking charge of the building of modern merchant and naval fleets. The next jump takes us into the transmission of our letters and telegrams. Then we are reminded of the protecting care of compressed air in handling switches and signals for our greatest safety and speed. We pass along to liquid air, described at length and carefully keeping the history of this new development before the public up to date. Then we read how the gold which pays for much of this development is precipitated through the use of compressed air through agitation, increasing the capacity of cyanide process plants. The homely but useful market basket is indebted to compressed air, and mining work, too, is touched on. Our day's work over we finally land on a compressed aid bed with a well defined impression that compressed air is to-day about the most startlingly prominent thing before the engineering public and is impartially championed and put forward by a journal acting on the theory that compressed air is healthy enough today to stand alone and needs only to have the facts impartially told about it.

With kindest regards and wishing you continued success in your work, we are,

GEO. R. MURRAY.

I have to congratulate you on your new cover, June issue.

Madison Cooper.

Minneapolis, Minn.

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215 Heath St.,

Roxbury, Mass., May 29, 1899.

Editor "Compressed Air:"

Being a reader of your paper, and being interested in Carbonic Acid Gas Compressors, I would like to ask you if you know of any lubricant for use on such Carbonic Acid Gas Cylinders that no trouble will occur from the gas being impregnated with foreign odors. What would you advise as a lubricant for same? This is for a compressor for 1,200 lbs. pressure. Also what would be the best arrangement for stuffing boxes to prevent leakage? Yours very truly,

J. J. FINLAY.

Glycerine is used where perfect freedom from odor is required. Cottonseed oil has been used, and if applied sparingly in the stuffing boxes and cylinders is almost odorless. For packing the piston rod of a double-acting carbonic acid gas pump, any of the mixed fibre and rubber packings; the "Garlock" or "Selden" are good. For a plunger pump, cupped leather rings should be used.

PATENTS GRANTED MAY, 1899.

Specially prepared for COMPRESSED AIR from the Patent Office files by Grafton L. McGill, Washington, D. C.

624,103. Air Brake Safety Attachment. A. C. Rumble, Oakland, Cal.

This is a device for opening communication between the train pipe and the open air in case of accident. It consists of a tube connected with the pipe, having a removable section at its lower end lying in proximity to the rails. This removable section is provided with a lateral arm having a normally closed destructible joint which is broken when the arm strikes a fixed object, thus opening the joint.

624,002. Air Forcing or Compressing Device. F. W. Ensign, Chicago, Ill.

A pneumatic arrangement for closing doors, etc.; consists of a cylinder containing a plunger, the latter having a hollow rod secured thereto provided with a flange. A spring is sleeved on the rod between the flange and cylinder, while a second rod, working loosely on the first mentioned one, is formed with an abutment designed to come against one end of said first rod and force it into the cylinder against the inertia of the spring.

624,201. Pneumatic Despatch Tube System. E. A. Fordyce, Chicago.

The door closing the terminal portion of the tube is connected to a valve located in the motor-fluid-supply pipe. In its closing movement the door first closes the tube to the atmosphere and then, by a further traverse, operates the connections whereby the valve is opened. A latch holds the valve open after the door is fully closed and is withdrawn by means of a motor operated by the fluid pressure.

624,202. Pneumatic Carrier System. E. A. Fordyce, Chicago, Ill.

The despatch tube is provided with sliding gates in its terminal portion. These gates are separated so as to receive the carrier between them and are moved by pressure chambers having pistons. Pipes are connected with the pressure chambers for conveying the pressure fluid thereto from the main despatch tube, while a manually-operated valve controls such pipes whereby the gates may be closed in due order and relation. The receiving tube communicates with the despatch tube near their respective terminal portions, the terminal portion of the despatch tube having a by-pass leading thereinto behind the carrier, while a portion of the motor fluid is diverted through said by-pass for expelling such carrier. The main tube and its branch are provided with grooves in their lower walls adapted to receive the carrier-wheels, while a switch and guide-rib, located at the junction of the two passages, operate to divert the direction of the carrier.

623,970. Pneumatic Despatch Apparatus. B. C. Batcheller, Philadelphia.

A sending apparatus, operated by a motor, is adapted and arranged to inject a carrier into the transit tube. The said motor is controlled by a power-controlling device, and an actuating lever has resilient connection with the latter, and is provided with a spring actuated lock whereby it is secured in position for actuating such device. Means are provided for temporarily preventing the motor-controlling device from moving under the pressure of the lever, while a pneumatic cylinder and piston are arranged to disengage the lock. A conduit for motive fluid leading to the cylinder is provided with valves which are opened by a trip operated by the exit of a carrier, the valves being closed by mechanism actuated by the motion of the lever lock.

623,971. Pneumatic Despatch Apparatus. B. C. Batcheller, Philadelphia, Pa.

This device is also adapted to have the carrier injected into the transit tube by means of a sending apparatus. The apparatus is actuated by a lever which is locked in operative position. The tube is provided with an internal finger adapted to be engaged and depressed by a carrier passing over it. Connections between the lever lock and the finger operate to release the former as the finger returns to its normal position after being depressed.

623,972. Carrier. B. C. Batcheller, Philadelphia, Pa.

This patent covers the construction of the carrier and the operation of its adjuncts. A cap closing the end of the shell is secured thereto by bolts, which latter are operated by a lever. A lock is arranged to normally hold the lever and thus prevent the motion of the bolts locking the cap, means being provided whereby when the cap is placed in its proper position the locks are withdrawn and the bolts permitted to operate through the medium of the lever.

623,973. Carrier Receiving Mechanism. B. C. Batcheller, Philadelphia, Pa.

The tubular receiver is provided at its rear end with a valve-seated opening, the latter having an exhaust opening connected therewith which is provided with a valve. A pneumatic spring connects the said valve and the transit tube, so that the normal pressure in the latter holds the valve closed, while it is permitted to move upon the increase of pressure within the tube due to the entrance therein of a carrier. The pivoted, motor-actuated receiver is adapted to move into and out of registry with the tube, the motor-controlling mechanism being actuated by the pressure within the receiver.

623,968. Pneumatic Transmission System. B. C. Batcheller, Philadelphia, Pa.

One of the principal features of this invention comprehends a checking of the motor of a carrier as the latter approaches the junction of a main tube with its branch, whereby when such carrier is checked suitable means will be engaged and actuated for automatically moving a switch at the junction of the tubes. A gate is arranged in advance of the junction of the two tubes, its function being to close and open the main transmission tube. An air by-pass conduit connects with the main tube on either side of the gate, the connection on the front side leaving a dead-air space. In this space is located mechanism operated by an electro-magnet for opening the gate, the circuit in which such electro-magnet is placed being normally open, but closed upon the approach of a carrier. A similar electro-magnet operates the switch, its circuit being closed by a selecting device arranged upon the carrier.

623,969. Pneumatic Transmission System. B. C. Batcheller, Philadelphia, Pa.

A loop extends from and to the main line of tubes, the latter having a gate intermediate of its ends. The switches at the junction of the ends of the loop with the main line are actuated by cylinders which also operate the gate so as to include or exclude the loop from the system. A signal indicating the condition of the tube circuit is operated by means of a connection with each separate actuating device for the switches and gate.

624,009. Pump for Compressing Air. Alfred Roesch, Bridgeport, Conn.

A casing is adapted to tilt or rock a limited distance and contains a diaphragm, the latter having a water inlet and discharge

on one side and an air inlet and discharge on the other which communicates with the interior of the casing and are provided with valves operated by the tilting of the casing. A rod is connected to the diaphragm and to a lever mounted on the casing, whereby the movement of the diaphragm tilts the casing through the medium of the lever.

624,830. Hydraulic Air Compressor. John Liming, Philadelphia, Pa.

A tank contains a discharge valve and a float-valve lever, the latter having an upwardly-projecting arm with a weight thereon, the arm being so disposed that when the valve is closed the weight will tend to keep it so and when opened to keep it open. The lever acts upon and closes a valve in a water-inlet-pipe, said lever being actuated by water coming from an escape pipe.

624,750. Gas Engine. W. H. & J. Butterworth, Trenton, N. J.

The rear ends of a cylinder and a water-jacket, the latter encircling such cylinder, are connected by a plate having a single bearing surface and separate openings leading into the cylinder and jacket, respectively. A cover is provided for closing the cylinder and a separate cover for closing the holes in the plate.

624,998. Compound Air Compressor. G. W. Wallick, Sturgis, Michigan.

This is a compound compressor, its larger cylinder having a solid piston, with its rod, and an inlet check-valve and an outlet-tube. A clamp encircling the cylinder is pivoted to the lower end of a lever. The smaller cylinder, having a hollow piston rod and a valvular piston, is provided with an inlet-tube and an outlet check-valve. This cylinder is also encircled by a clamp connected to a fulcrumed lever, the lower jaw of which is secured to the piston rod of the larger cylinder, while a flexible pipe connects said larger cylinder to the piston rod of the smaller cylinder. The lever mentioned in connection with the larger cylinder is pivotally connected to a sleeve encircling the piston rod of the smaller cylinder, while an adjustable rod connects the lower part of said lever with the upper jaw of the lever supporting the smaller cylinder, and operates said lever.

625,324. Valve for Air Motors. James Craig, Jr., New York, N. Y.

A reducing valve having a spring-actuated flexible diaphragm, is operated by a valve-stem, the latter being connected with a member engaging toggle mechanism controlled by the operator whereby the valve is closed and held to its seat.

625,325. Reducing Valve for Air Motors. J. Craig, Jr., New York, N. Y.

This valve employs two diaphragms, one being of less effective area than the others, both connected to and arranged to operate the valve. A chamber located between the diaphragms communicates with the delivery port of the valve and with the outside air to throw the separate diaphragms into and out of operation, thereby varying the delivery pressure of the valve.

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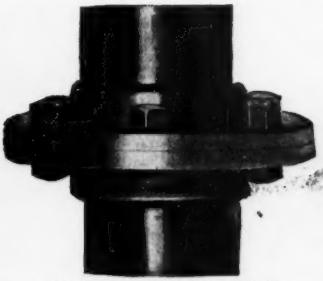

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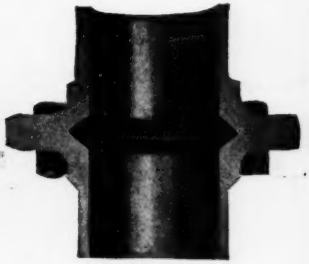

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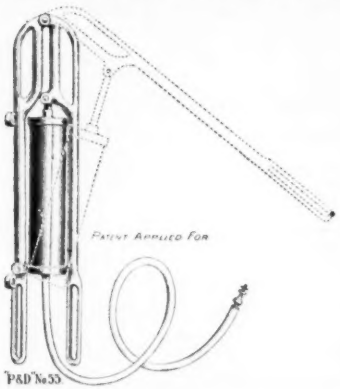

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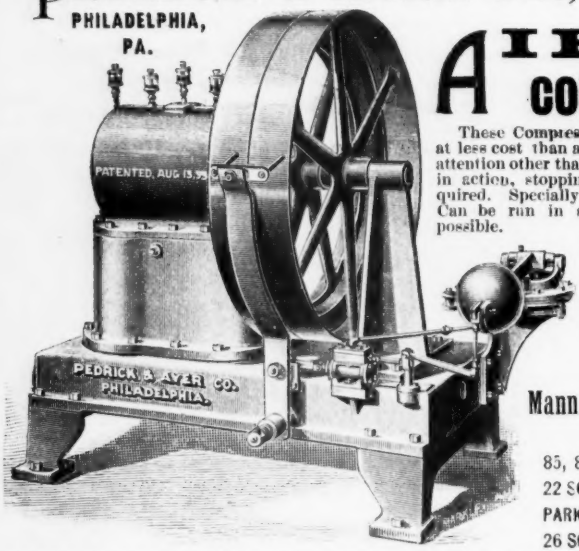

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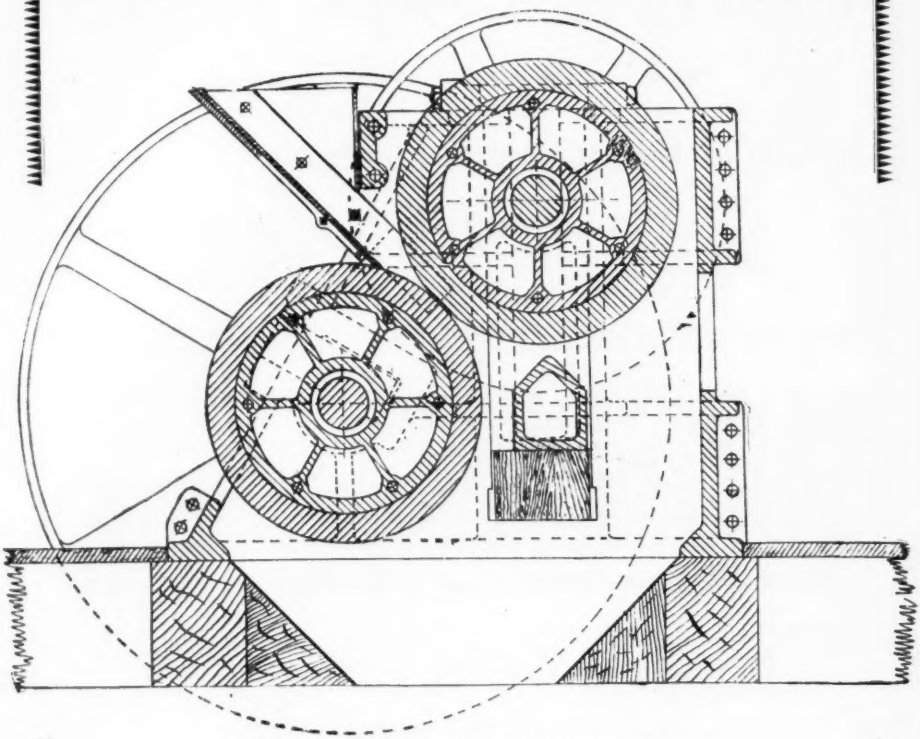

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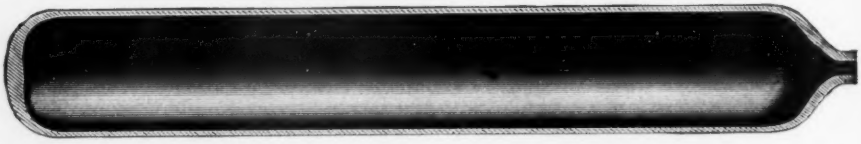

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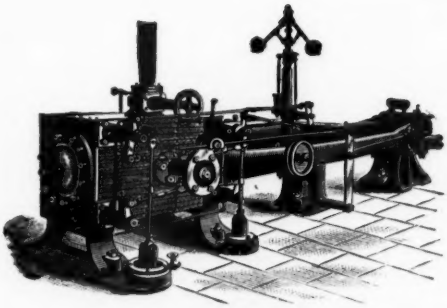

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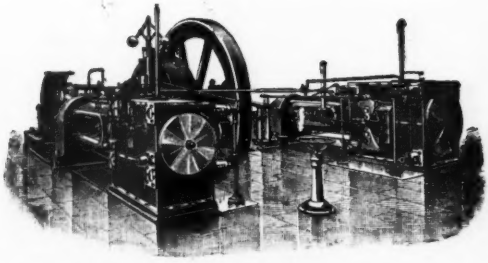

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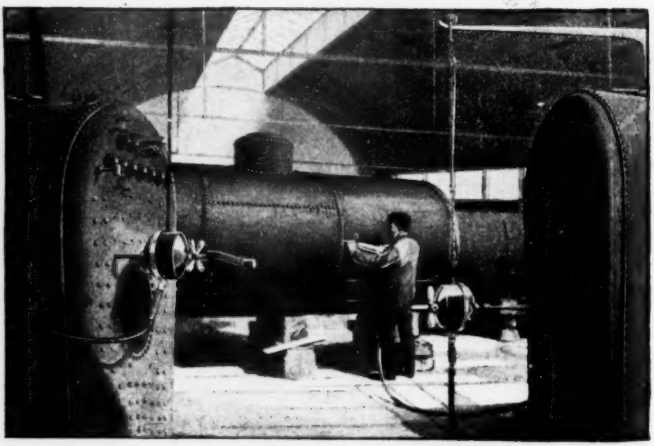

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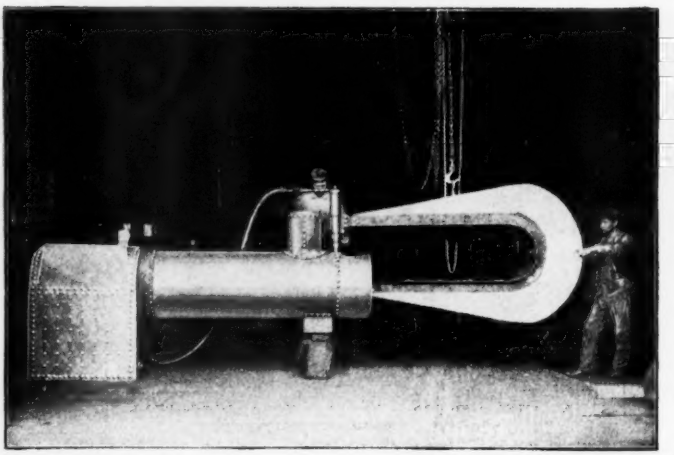

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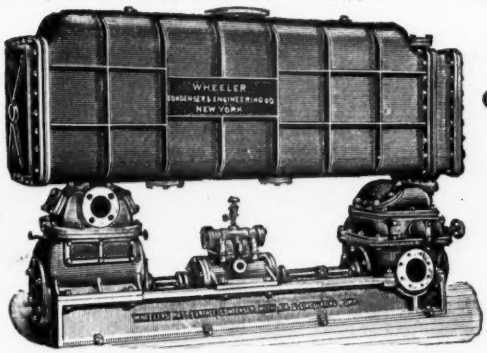

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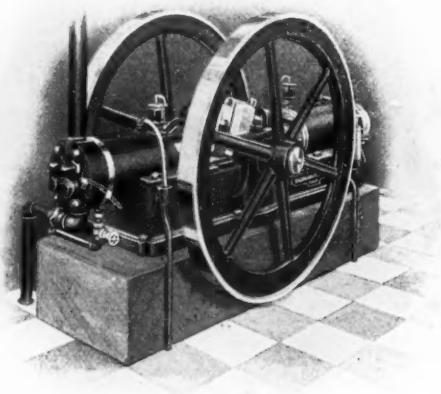

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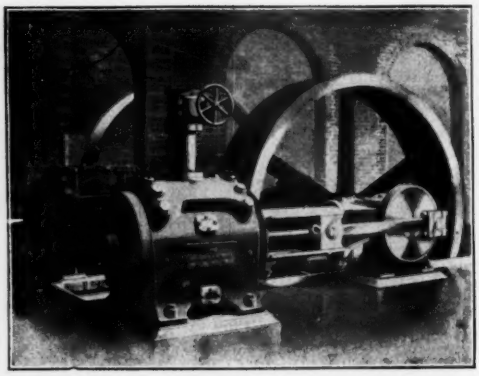

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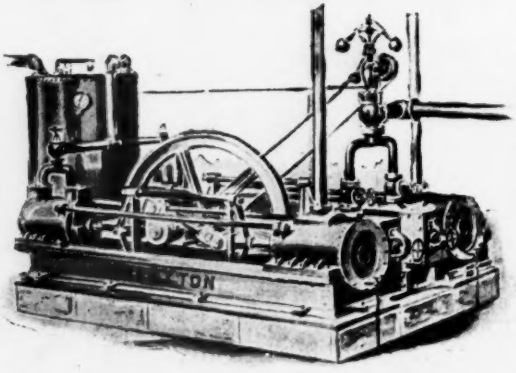

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